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the ice contain water, and are thought to be due to the closing of water-filled crevasses. The presence of water-filled cavities within the ice of glaciers shows that the winter's cold does not penetrate far below the surface.

An ingenious arrangement consisting of two sticks placed in diverging auger holes and inclined toward each other and securely bound together with wire at the surface of the ice, gave accurate measures of the rate of surface melting. In general, the waste on the surface of Muir glacier was two inches per day. Soundings in Muir inlet, which also furnished water samples from various depths, measurements of temperatures for the surface to the bottom, and samples of the bottom, gave a series of instructive records, which are briefly discussed. Tidal observations made in Tidal inlet, a small fiordlike bay, five miles west of the head of Muir inlet, furnished data for establishing a permanent bench mark on the shore by means of which changes of level of the land can be measured. It is hoped that future travelers will repeat these measurements and also profit by the instructions which are given for photographing the extremities of the tide-water glaciers, so that a record of their variations may be obtained.

The report before us contains the records of the only systematic survey that has been made of any of the Alaskan glaciers, and is of special value on account of the painstaking accuracy that characterizes the work. A splendid beginning has been made in the study of the great system of ice drainage that pours into Glacier Bay. It is to be hoped that other students of glacial phenomena, having before them this example of what can be accomplished during a summer vacation, will continue the work and explore the unknown regions surrounding the area represented in Professor Reid's map on every side.

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ISRAEL C. RUSSELL.

*Water Resources of Illinois.* By FRANK LEVERETT; Seventeenth Annual Report U. S. Geological Survey, pp. 695-849, Washington, 1896.

This paper contains much of distinct geological interest, as may well go without saying, both on account of the intimate connection of hydrology with geology, and, in especial, because of the author's thorough study of the Pleistocene formations of the state. The effect of the drift upon topography and drainage is set forth with considerable detail. On the newer drift, within the Shelbyville moraine,

preglacial features are for the most part concealed. The drainage systems are comparatively young, although the streams have the advantage of working on a surface of higher altitude and greater diversity of relief than that of the older drift of central and southern Illinois. Streams follow the axes of drift basins included between successive morainic ridges, their longer tributaries being carried on the longer slopes of these basins which lie toward the west and south. A preglacial divide is traced from below Elgin and Lemont to the Indiana state line, and it is highly probable that the headwaters of the Fox, Des Plaines and Kankakee rivers were in preglacial times tributary to the Lake Michigan basin. In northwestern Illinois instances are noted of displacement of the rivers and their beheading by drift deposits. The data supplied by artesian well records suggests several important conclusions as to the deeper strata. The altitudes of the St. Peter sandstone and the base of the Coal Measures are worked out in detail over much of the state. Three thousand feet is considered a liberal estimate for the thickness of the Palæozoic formations of northern Illinois. A maximum of 6000 feet is set for the thickness of the Palæozoic in southern Illinois, of which from 1200 to 1500 feet is allotted to the Coal Measures. The terms Potsdam and Lower Magnesian are retained, and a thickness is assigned to the latter at Rock Island of about 800 feet. In this instance it seems probable to the reviewer that this measure includes the Jordan and Saint Lawrence as well as the Oneota or Lower Magnesian. Remarkable variations in well records are noted, and, like all workers with such data, the author has no doubt felt the embarrassment of riches when more than one well record is extant in any district. At Chicago, for example, the recorded thickness of the St. Peter sandstone ranges from 89 to 420 feet. Surely in the latter measurement the driller, or the authority for the record, has either reckoned in arenaceous beds of the Oneota and the New Richmond, or has been misled by St. Peter sand in drillings far below the lower limit of the formation.

The Potsdam, the St. Peter, the Galena, the Lower Magnesian, and the Niagara, are the chief artesian water-bearing strata.

The author does not find it easy to separate flowing from non-flowing wells in which water rises under hydrostatic pressure, and designates both classes as artesian. He instances wells in Chicago which pass from one class to the other each week, flowing only for a brief period after the Sunday intermission from pumping of neighboring wells.

An interesting fact is the control of artesian head by the height of ground water in the cover area, and several instances are adduced of the head being raised by true influx of surface waters. Under the most favorable conditions the head from the St. Peter and the Galena appears to reach about 675 feet A. T., while from the Potsdam it appears to rise slightly above 700 feet. Few wells in northern Illinois can be depended upon to maintain a head much exceeding 600 feet A. T. A few examples are added to the many on record of local artesian regions whose head is lowered by over draft. In the Chicago district the head of the St. Peter water has been drawn down nearly 100 feet, and this loss of pressure extends ten miles and over west and south of that part of the city where the wells are now numerous. At Joliet heavy pumping of a single well has been found to lower the head several feet in wells nearly one-half mile distant. The increase of mineralization of artesian waters with increase of distance from the area of intake is amply illustrated, sodium chloride, for instance, ranging from about three grains to the gallon at Chicago to about 30 at Rock Island and 277.7 at Barry.

Of less interest to the geologist are the chapters treating of the rainfall, the run off of the streams, and kindred topics. In the chapter on the water supply of the cities and towns, the statement that "the Chicago intakes are affected by sewage only when the Chicago River is at high stages, which seldom amounts to more than a few days each year," is certainly one that does not err from lack of moderation. The final chapter, by Professor J. A. Udden, treats with fullest detail of the artesian district of Rock Island and vicinity. The report is amply illustrated with maps and sections, and it places on permanent record a mass of valuable statistics in several fields. The details, however, are so handled that they do not interfere with the author's direct and luminous treatment of the subject.

W. H. NORTON.

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*The Geology of Santa Catalina Island.* By WILLIAM SIDNEY TANGIER SMITH. Proceedings of the California Academy of Sciences, 3d Series, Geology, Vol. I, pp. 1-71, 2 plates and map.

The chief interest in this paper lies in the clear and generally convincing manner in which the author has discussed the physiographic problems presented by his very attractive field; his work being in that respect a continuation of the previous work of Lawson.